VI

HANDBOOK of INSTRUCTIONS for INSTRUMENT SHOP

UNIVERSAL MICROWAVE POWER SUPPLY MODEL Z 817A

FXR, Inc.
26-12 BOROUGH PLACE, WOODSIDE 77, NEW YORK

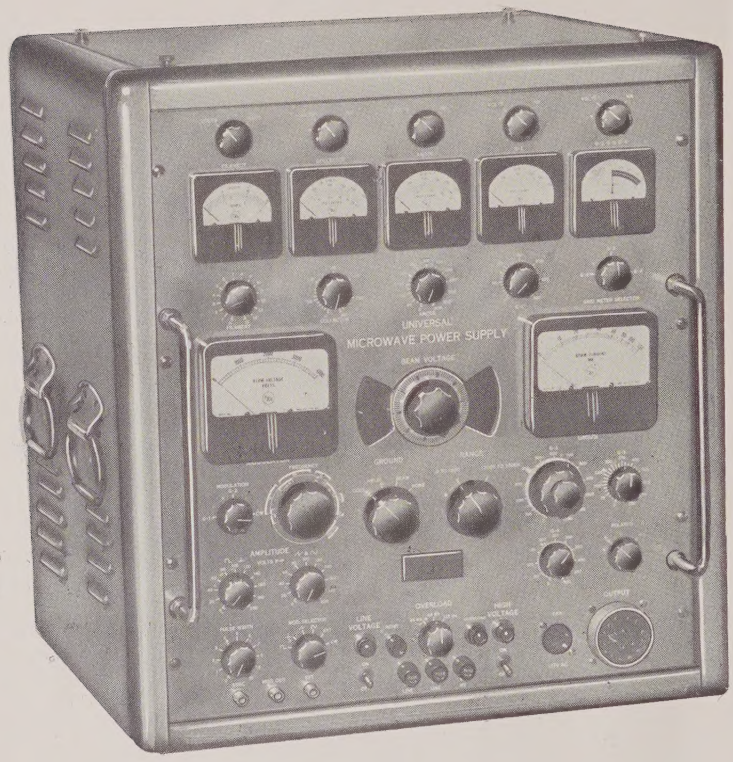

FIGURE 1 FXR MODEL Z817A UNIVERSAL MICROWAVE POWER SUPPLY

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SECTION I
INTRODUCTION

1. APPLICATION

1.1 The FXR Universal Microwave Power Supply is designed to be used as a general laboratory instrument with specifications benefiting the users of klystrons and other microwave signal sources. When used with the klystron, this unit will provide all the necessary voltages to power almost every laboratory klystron. It is particularly useful in the manner in which the modulator may be used, i.e. information may be supplied via direct coupling to the reflector supply for automatic frequency control or for extremely slow sweeping voltages in special test set-ups. The voltages are sequenced in order to make certain that in all cases reflector and control grid voltages will be the first applied voltages after the filament.

1.2 The other most common microwave sources of power, BWO, TWAT, and VTM may also be successfully energized by this power supply. In particular, this supply contains a total of five (5) electrode voltages to be applied at the cathode end of the tube and a collector voltage at the helix end. It also contains a variable D.C Filament supply and full metering on all sources. The modulator is set at the cathode side of the tube thereby permitting modulation even in the event that the FXR Z818A (Voltage Sweeper) is used. In addition, the external or AGC is designed in such a manner as to permit effective direct coupling to either the anode, G-1 or G-2 thereby permitting automatic gain control even while sweeping.

1.3 Aside from the above uses, the Z817A fulfills all the specifications and requirements of a general laboratory power supply. It should be noted from examination of paragraph 2.2 of Section II (Specification Summary) that this unit compares favorably at any voltage and current rating to the finest laboratory power supplies available today.

2. GENERAL DESCRIPTION

2.1 A Universal Microwave Power Supply is a multiple energy source designed to have sufficient capacity to meet the needs of present and future developments in the microwave signal source field. Basically, the FXR Universal Microwave Power Supply consists of ten (10) components.

2.1.1 The filament supply is a variable D. C. line regulated source delivering from 0 to 15 volts at a maximum 3 amperes or 20 watts, whichever is greater.

2.1.2 The collector supply is a fully regulated variable supply with an output of from 0 to 300 volts either side of which may be connected to any point within 3000 volts of ground. A front panel control permits direct pre-setting of voltage. A meter switch allows observation of either voltage or current.

2.1.3 The anode supply is a fully regulated variable supply with an output of from 0 to 600 volts whose negative side may be connected to any point within 3000 volts of the negative side of the helix or beam supply. The negative side of the anode supply is the common point of G-1 (Positive Side) and G-2, G-3, and G-4 (Positive or Negative Side) via front panel switch.

OTE:
R 300V OUTPUT
TERNAL" SW ON
PULATOR MUST BE
"ANODE OR G-2"
UTION

2.1.4 The G-1 supply is a medium impedance supply intended primarily to operate under no load conditions with a voltage output of from 0 to 300 volts. It also is operated by a front panel control and has a meter for reading both voltage and current.

2.1.5 The G-2, G-3, and G-4 supply are all high impedance supplies operating together from the same regulated source giving 0 to 1200 volts, 0 - 750 volts, and 0 - 500 volts respectively at a maximum of 1 Ma. These supplies may be connected

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either positively or negatively to the common point of the anode G-1 supply. G-2, G-3, and G-4 may be observed on a single 0 center voltmilliammeter, one side of whose scale is red to indicate 'DANGER' in the event that the unit is being used for a klystron and the reflector voltage (G-2) is set with a positive rather than a negative potential.

2.1.6 The helix or beam supply is the main energy source of this unit and it supplies from 0 - 3500 volts in two ranges. A front panel switch provides means of grounding either side or of allowing the unit to float. Provision is made for pre-setting of the required voltages to ±1% before the high voltage is turned on. Besides a vernier dial which permits resolution of 0.5 volts and resettability of 2 volts, there is a fine auxiliary control allowing a resolution of 0.03 volts and a fine setting of 0 - 7.2 volts. The supply is provided with a continuouously variable overload protection.

2.1.7 The modulator provides square, pulse, sawtooth, or sine wave modulation for anode G-1 or G-2, G-3, and G-4 (reflector) supplies. The modulator voltage is variable from 0 to 200 volts when applied to the reflector (G-2, G-3, G-4) and G-1 supplies, and from 0 - 550 volts when applied to the anode supply. The square wave frequency is variable from 250 to 2500 cps, and the sawtooth is variable from 40 to 120 cps. The sine wave modulation is available at the line frequency only and the pulse Rep. Rate is variable from 250 to 2500 cps with a variable width from approximately 1 - 10 μsec.

2.1.8 A BNC connector provides for the application of External or AGC modulation to the Anode, G-1, or G-2, G-3, G-4 supplies independently or simultaneously with the internal modulation signals. The system provides a 3 db band pass from D.C. to 50 kc. The maximum EXT. input signal will produce a change of 35 volts in the anode supply, with or without internal modulation. When applied to the G-1, or G-2, G-3, G-4 supplies, this signal will produce a change of 100 volts without internal

modulation or with sine or sawtooth modulation. With internal pulse or square waves applied simultaneously, the external 16 volt peak-to-peak signal will produce a change of 25 volts in the G-1, or G-2, G-3, G-4 supplies.

3. SPECIFICATIONS

3.1 Input voltage 105 - 125 volts, 50 or 60 cps.

3.2 Input power 300 - 1000 watts.

3.3 Output - Filament Voltage

OPEN CKT.

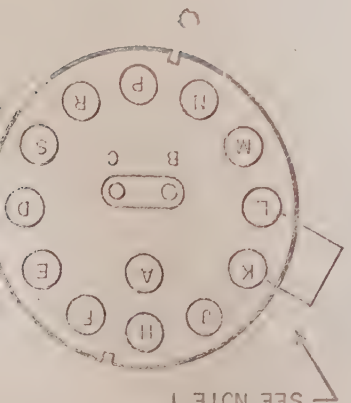
Range: 0 - 15 volts at 0 - 3 amperes or 20 watts whichever is greater.
Resolution: Better than 0.1 volts.
Regulation: 1% from 105 - 125 volts.
Internal Impedance: Less than 4 ohms.
Ripple: Less than 5% at maximum rated current decreasing to 0.01% at no load.
Stability: 1%
Temperature Coefficient: Better than 0.1% per degree centigrade.
Insulation: May be operated 0 - 3000 volts positive to Beam (-).

D & E
4 OHMS @ 15V DC - NOTE REGULATION (LOAD) IS CRITICAL

Collector

Range: 0 - 300 volts at 0 - 100 Ma.
Resolution: Better than 0.5 volts.
Regulation: 0.005% from 105 - 125 volts.
Internal Impedance: Less than 0.2 ohms from 0 - 30,000 cps.
Ripple: Less than 3 MV RMS.
Stability: 0.05% per day.
Temperature Coefficient: 100 ppm/°C.
Insulation: May be operated 0 - 3000 volts positive to Beam (-).

N & H



Anode Supply (WITH FRONT PANEL "INTERNAL SW. ON G-2)

C & F

Range: 0 - 600 volts at 0 - 60 Ma.
Resolution: Better than 0.5 volts.
Regulation: 0.005% from 105 - 125 volts
Internal Impedance: Less than 0.2 ohms from 0 - 30,000 cps.
Ripple: Less than 3 MV RMS.
Stability: 0.05% per day.
Temperature Coefficient: 100 ppm/°C.
Insulation: May be operated 0 - 3000 volts positive to Beam (-).

G-1

WITH "INTERNAL" SW IN "ANODE" OR "G-2" POS.

P & F

Range: 0 - 300 volts at 0 - 5 Ma.
Resolution: Better than 0.5 volts.
Regulation: 0.005% from 105 - 125 volts.
Internal Impedance: 30K
Ripple: Less than 3 MV RMS.
Temperature Coefficient: 100 ppm/°C.
Insulation: May be operated 0 - 300 volts positive to Beam (-).

G-2 = A & R WITH G-3 ON ZERO
G-3 = A & R WITH G-2 ON ZERO
G-4 = A & S WITH G-2 ON ZERO

G-2, G-3, G-4

Range: G-2, 0 - 1200 volts at 0 - 1 Ma.
G-3, 0 - 750 volts at 0 - 1 Ma.
G-4, 0 - 500 volts at 0 - 1 Ma. (MUST)
Resolution: Better than 1 volt.
Regulation: 0.005% from 105 - 125 volts.
Internal Impedance: G-2, 200K
G-3, 150K
G-4, 220K
Ripple: Less than 3 MV RMS. (7MV?)
Temperature Coefficient: 100 ppm/°C.
Insulation: Internally connected to Anode (-).

M & B → CHECK AT 500V. DUE TO POSSIBLE BREAKDOWN OF CORRSTAT AT HIGHER VOLTAGES

Helix or Beam Supply

Low Range: 0 - 1800 volts at 0 - 125 Ma.
High Range: 1700 - 3500 volts at 0 - 100 Ma or

250 watts whichever is less.

Resolution: 0.5 volts on main control.
0.03 volts on auxiliary fine control.

Regulation: 0.005% from 105 - 125 volts.

Internal Impedance: Less than 0.2 ohms from 0 - 30,000 cps.

Ripple: Less than 3 MV RMS.

Temperature Coefficient: 100 ppm/°C.

Insulation: Positive or negative grounded by front panel switch.

Modulation

Square Wave

Frequency: 300 - 2000 cps.
Voltage: Anode, 0 - 550
G-1, G-2, G-3, G-4, 0 - 200.
Rise: 1 μsec per 100V.
Fall: 1 μsec per 100V.

Sawtooth Wave

Frequency: 40 - 100 cps.
Voltage: Anode, 0 - 550
G-1, G-2, G-3, G-4, 0 - 200
Rise: 1 μsec per 100V.
Fall: 1 μsec per 100V.

Sine Wave

Frequency: Line
Voltage: Anode, 0 - 550
G-1, G-2, G-3, G-4, 0 - 200

Pulse Wave

Rep. Rate: 300 - 2000 cps.
Width: 1 - 10 μsec.
Rise: 1 μsec per 100V.
Fall: 1 μsec per 100V.

External or AGC

Max. Input: 10 volts P-P.
Frequency: D.C. to 50 Kc.

External or AGC Spec.
Modulator Supply Voltage Change
10 Volt Peak-To-Peak Input Change

	No Internal Mod.	- Internal Saw	+ Internal Saw	+Internal Square	+ Internal Pulse
Anode Supply	35 V	35V	35V	35V	35V
G-1, G-2 G-3, G-4 Supplies	100 V	100V	100V	25V	25V

3.4 Metering.

Filament

Voltage: 1 - 15 volts, ±2% accuracy.
Current: 0 - 3 amperes.
Linear Scale: Front panel control to read voltage or current.

Collector

Voltage: 0 - 300 volts, ±2% accuracy.
Current: 0 - 120 Ma, ±2% accuracy.
Non-linear Scale: Front panel control to read voltage or current.

Anode

Voltage: 0 - 600 volts, ±2% accuracy.
Current: 0 - 90 Ma, ±2% accuracy.
Non-linear Scale: Front panel control to read voltage or current.

G-1

Voltage: 0 - 300 volts, ±2% accuracy.
Current: 0 - 5 Ma, ±2% accuracy.
Non-linear Scale: Front panel control to read voltage or current.

G-2, G-3, G-4

Voltage: 0 center, 1200 - 0 - 1200 volts, ±2% accuracy.
Current: 0 center, 1 Ma - 0 - 1 Ma.
Linear Scale: Front panel control to read voltage or current. Front panel control for G-2, G-3, and G-4 indication.

Beam or Helix Supply

Voltage: 0 - 4000 volts, ±2% accuracy, linear scale.
Current: 0 - 125 Ma, ±2% accuracy, non-linear scale.

3.5 Overload Protection.

AC Line: Fuse 10 amperes.
HV Line: Fuse 8 amperes.
Helix or Beam
Overload: Variable overload relay 10 Ma - 125 Ma continuous.
Collector
Overload: Fixed overload relay 100 Ma.

Anode
Overload: Fixed overload relay 60 Ma.

3.6 Terminals.

Amphenol Type 405 or equivalent, 15 pin connector for all voltage, mating connector supply. Front panel BNC connector for External or AGC modulation. Rear BNC connectors for output of modulator. Female 2 pin connector to supply 117 volts A. C. to external fan (not supplied).

3.7 Dimensions - For rack mounting standard 19" relay rack panel 21" high, 21" deep.

3.8 Weight - Approximately 290 lbs.

3.9 Operable Klystrons - BWO, TWAT, and VTM.

3.10 Accessories - Output Connector.

SECTION III
OPERATING INSTUCTIONS

1. GENERAL PRINCIPLES OF OPERATION.

In order to test and maintain microwave energy sources and to perform accurate tuning and adjustment, the power supply must provide stable and accurate voltages to all of the elements of the microwave sources. This unit is intended to be as versatile with respect to its use as is possible for any commercially constructed test instrument. Protection of both the person and microwave source has been provided to the greatest extent possible.

2. CONSTRUCTION AND CIRCUITRY DETAIL.

2.1 Power Input Circuit. Power is brought into the unit through a line cord to P-301, Figure 3. From S-301, Figure 2, it proceeds to SW-201, Line Switch, and fuses F-201 and F-202. One side of the line from F-201 returns to P-301 and S-301 to act as an interlock through P and S-302, fan motor connectors, it then goes back through S and P-302 to the interlock in output connector S-201. This arrangement provides no power to the unit if the internal fan is not connected, or if a proper interlock is not inserted externally to pins J and K of output connector S-201. Upon turning Line Switch, SW-201 to "ON" the following occurs: The thermal element of Thermal Delay Relay TRE-301 is energized, line pilot light PL-201 goes on and A. C. outlet S-202 on the front panel is live. Transformers, Figure 3, T-306, Beam Rectifier Filament Supply; T-307, Reflector, Mod. and Beam Pass, Filament Supplies; T-308, T-309, and T-201 (Figure 2) Constant Voltage Transformer, Filament Variac and Filament Power Transformer are energized. Through pins 5 and 6 of S and P-401 (Figure 4), T-405, Coll, Anode, etc. Pass Tube Filament Supplies and through pins 6 and 7 of S and P-401, T-406, Coll., Anode, and Beam, etc., Regulated Amplifier Filament Supplies; and T-301, T-302, and T-303 Overload Coupling Transformers are also turned on.

After 60 seconds, Thermal Delay TRE-301 contacts close and R-301 is shorted out and RE-301 is energized. R-301 acts to par-

tially close RE-301 so that no chatter will occur as TRE-301's contacts close. Upon closing, RE-301 clamps itself and de-energizes TRE-301 with one set of contacts and closes one side of Line to HV Switch SW-202 (Figure 2) through S and P-301. The fact that TRE-301 is permitted to cool immediately after closing insures that each time the unit goes on a proper time delay will be experienced (providing the "ON" period is greater than 60 seconds).

2.1.1 Sequencing. Upon turning HV Switch (SW-202) "ON" the following sequence of events takes place: Power is fed to Pilot Lamp PL-203 and to T-401 and T-404 through pins 1 and 2 of P-401 (Figures 2 and 4) also from pin 1 of P-401 and one side of T-402 and T-403 become alive. Through pins 1 and 2 of S and P-303 (Figures 2 and 3), RE-307 is energized, its contacts GRE-307 energize RE-308 and complete the circuit of the Collector Variac T-203 through pin 5 of S and P-303, this energizes T-402 through pin 4 of S and P-401, also T-204 Beam Variac and T-304 Beam Power Transformer are turned on through pins of P and S-303. When RE-308 closes its contacts C-RE-308, the Anode Variac (T-202) is turned on through pin 3 of S and P-303 energizing T-403 through pin 3 of S and P-401. The sequence of T-305 (Figure 3) the Reflector Power Transformer depends on the position of SW-213 which is a mechanically linked part of SW-205 Polarity Switch of the G-2 Reflector G-3, and G-4 supply. In the (-) position, power is delivered to T-305 directly upon closing SW-202; through pins 1 and 4 of S and P-303, when in (+) position T-305 is not energized until contacts C-RE-308 close.

The total sequence is as follows:

Line on (SW-201) - All internal Filaments and D. C. output Filament on. Overload relays set, Line Pilot Light on, Thermal Relay energized.

60 second delay (TRE-301) - Thermal Relay energized, HV Relay locked in prepared for HV "ON" if SW-202 has not already been turned on.

HV "ON" (SW-202) = Pilot Light "on," G-1 supply "on" (T-404 Modulator Transformer Section) and G-2, G-3 (Reflector), G-4 Supply if Polarity Switch is on (-) • RE-307 energized = Collector Supply and Beam Supply on • RE-308 energized = Anode Supply and G-2, G-3, G-4 (Reflector) (if Polarity Switch is on (+).

2.1.2 Overloads. This unit is provided with output overload protection in the Beam, Collector and Anode circuits. Since any one of these supplies may be at a high potential to ground, a high voltage coupling transformer is used to transmit overload information to the HV throw-out relay.

The mechanism is as follows: Should an overload occur, for example in the Beam Supply (Figure 3), then RE-306 closes its contacts (C-RE-306) shorting the secondary of T-303. The primary reflects this short by presenting a lower impedance in series with RE-305. This closes C-RE-305 energizing overload output relay RE-302 which locks itself closed and opens the HV line through its contacts C-RE-302. All overload relays and transformers have the same action. Reset switch SW-203 (Figure 2) resets RE-302 regardless of the overload relay originating the cut-out. The circuit of RE-302, SW-203 and Pilot Light PL-202 are interconnected by pins 8 and 9 of P and S-302.

2.2 Regulator Circuits

2.2.1 Typical Regulator Circuit

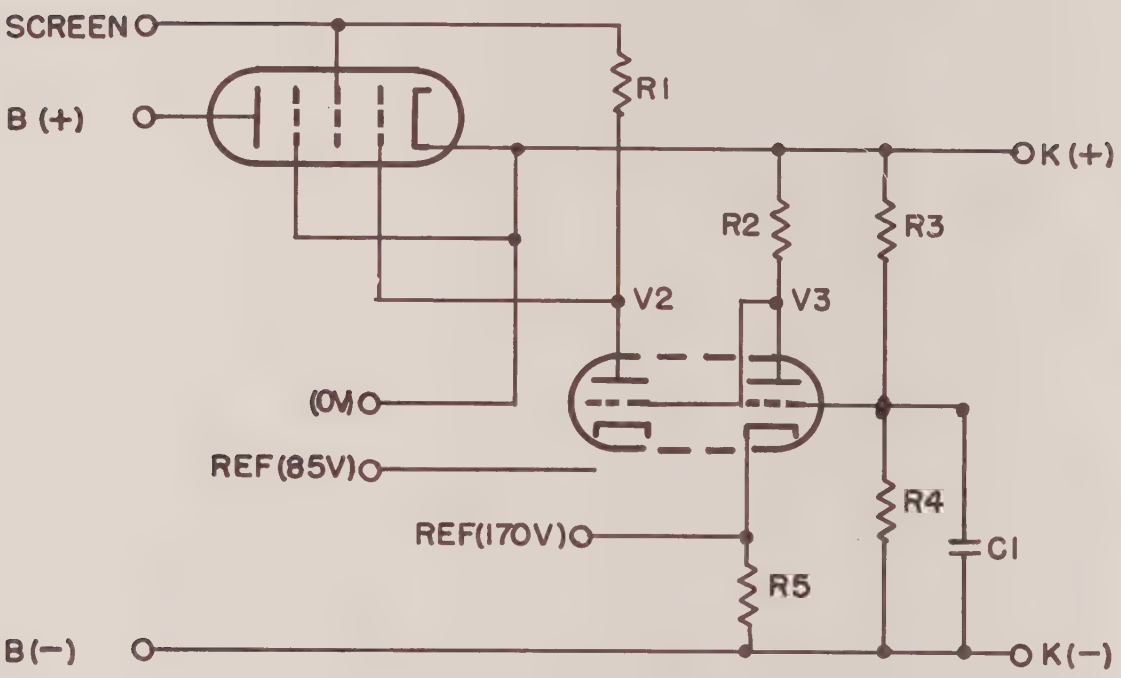


Figure A.

The operation of the typical Regulator Circuit of this unit may be shown by this simplified diagram.

Assume an increasing unregulated voltage between B(+) and B(-). This increasing voltage will show up across R3 and R4. In particular, the voltage across R-3 is increasing, since V-3 is referenced to K+. This means that the bias on the grid of V-3 will be increasing in a negative direction. This causes the current through this tube to decrease and R-2 will have a lower voltage drop which in turn becomes a decreasing bias on the grid of V-2 allowing more current to flow and therefore a larger drop across R-1 or a larger bias on V-1 increasing the drop across V-1 until

the change in voltage across K(+) to K(-) is minimized. The speed and accuracy of these changes will vary with particular circuits. The specifications are normally given in terms of regulation, i.e., % change in output voltage for % change in input voltage, and output impedance, i.e., change in output voltage for changes in load current. The speed will be indicated by the change in impedance for changes in load variation frequency. Output impedance rapidly rises at higher frequencies particularly if long leads are used to the load since these add appreciable inductance to the impedance of the supply.

2.2.2 Collector and Anode Supply, Figures 8, 9, and 2, these supplies are almost identical. Their differences are only in output voltage differences and sequencing. We will describe the collector supply, Figure 8, It consists of a fixed collector reference supply (200V) to allow for a zero base, and a variable main supply. These both function in the manner described in paragraph 2.2.1. The collector reference supply uses VR references V-807, and V-808 and VR screen supply V-806. The main supply uses a separate screen supply and a tracking reference supply consisting of V-802 and V-803 in series with R-807 and tracking potentiometer R-215. The function of R-807 in the VR chain and R-805 and R-806 in the sensing string is to compensate for the voltage of the collector reference supply so that the main supply may accurately go from zero to its maximum voltage (300V).

The anode, modulator, (G-1) supply consists of a fixed (300V) supply and a variable (0 - 600V) main supply. The sequence is such that the fixed supply goes on from 10 - 40 milliseconds before the variable supply.

2.2.3 G-1, Figures 9 and 2. The G-1 supply is taken directly from the anode fixed supply. This same source is the anode reference and modulator supply. In CW operation, G-1 is the output of a 30K, R-217, Figure 2, potentiometer placed across the 300 volt source. In modulator position, the output is clamped to present negative excursions from the CW position.

2.2.4 G-2 (Reflector), G-3, and G-4, Figures 6, 2, and 3. This supply is exactly the same as the previous supplies except that it uses a voltage doubler to develop the higher necessary voltage (1200 volt out).

The output voltage is fed through P and S-602 to SW-205, Figure 2, which permits reversing polarity with respect to the negative side of the anode supply. From SW-205 the power goes to R-206, the Reflector or G-2 supply, R-201, R-202 the G-3 supply, and R-203, K-204, R-205 the G-4 supply. In CW operation, these supplies are connected directly to the negative side of the Anode supply. Modulation is accomplished by direct coupling of the entire supply to the plate load of the Modulation output tube. Modulation is thereby applied to all (G-2, G-3, and G-4) simultaneously.

2.2.5 Helix or Beam Supply, Figures 5, 2, and 3. This supply differs from the others only in that there are three tubes in parallel as pass tubes of the variable supply and the range is changed by use of a switch. Because of the range, the component configuration has been changed somewhat. The operation, however, is exactly the same. Since the output of the variable supply is common on the positive side with the Beam Reference Supply, in this unit it is not necessary to use different VR's or screen supplies.

NOTE: NEVER CHANGE RANGES OR GROUND POINT WHILE HV SWITCH IS ON.

2.3 Modulation, Figure 7A. This unit provides two methods of providing modulation to three of the outputs. An internal modulator may be used to supply square wave, pulsed, sine, and saw tooth wave potential to either the Anode, G-1 or Reflector (G-2, G-3, G-4) supplies. An external system provides essentially direct coupling to any of the above electrode supplies. Provision is made for both modulation methods to be applied to the same supply simultaneously. This may be useful should AFC or AGC be necessary while square wave modulation is being used and only one control electrode is available on the microwave tube.

2.3.1 Modulator Power Supply. The Modulator floats at the negative side of the Anode supply. Most of its power is taken from the G-1 supply. The Ext. AGC contains its own power supply, Figure 7B.

2.3.2 Square Wave and Pulse, Figure 7. Square wave and pulses are derived from a phantastron oscillator, V-708, and Schmidt trigger, V-707, followed by a cathode follower, V-706B.

2.3.3 Saw Tooth and Sine Wave. The Sine wave is obtained directly from a sample of the filament supply. It is amplified by V-706A and fed to cathode follower V-706B. The saw tooth is derived from a phantastron oscillator, V-708, followed by a cathode follower.

2.3.4 Ext., AGC, AFC. The Ext. supply is a completly shielded AM system with a bandpass from D. C. to 50Kc. It consists of a crystal controlled oscillator at 60 Mc, V-751, followed by a screen modulated pentode amplifier, V-752. The output of V-702 is loop coupled to crystal diodes X-701 and V-752 which are connected in a double circuit to the modulator cathode follower V-758B and V-759.

2.3.5 Modulation System. Modulation for the Anode is supplied through V-703 and V-704B. V-703 is in series with the variable 600 volt Anode supply. This method provides a current carrying capacity, but limits the amplitude as the load changes. Modulation for G-1, G-2, G-3, and G-4 supplies is applied through V-705 and V-704A. One part of V-705 serves as a phase inverter when modulation is applied to G-1 supply and a cathode follower with G-2, G-3, and G-4 supplies. The modulation output is in series with the 300 volt G-1 supply and 1200 volt G-2 supply through V-704A.

2.4 Filament Supply, Figure 3. The Filament supply consists of a constant voltage transformer, T-308, followed by a Variac, T-201, Figure 2, and Filament transformer, T-309. A full wave bridge and capacity input section filter completes the supply.

2.5 Special Features.

2.5.1 Regulation. Extremely good line regulation is guaranteed by the high gain of the regulator systems, and the addition of filament regulation for the regulator amplifiers.

2.5.2 Rectifiers. To reduce weight and increase reliability, silicon rectifiers are used on all but the Beam supply.

2.5.3 Transformers. All transformers in this unit are constructed for minimum stray capacity to line and ground and maximum life, via internal mylar HV insulation and either hermetically sealed oil or a double vacuum varnish construction.

2.5.4 Construction. Special precautions have been taken to provide adequate HV insulation for all circuits including the use of plastic board construction and teflon wiring wherever necessary.

SECTION IV
MAINTENANCE

1. INSTALLATION ON THE BENCH. The Universal Microwave Power Supply is supplied in a standard Relay Rack Cabinet suitable for use in any bench testing set-up. The cabinet may be placed in any position desired if sufficient air space is provided at the rear to draw and vent air for internal cooling.

The line cord may be inserted in any power line providing 105 to 125 volts, 50 to 60 cps and capable of carrying a 1000 watt load. For safety connect the third lead in the line cord to a good ground. For minimum ripple, it may sometimes be necessary to reverse the input power plug.

These units are designed for either 50 or 60 cycle operation, only one component, the constant voltage transformer, T-308, need be changed to convert from one frequency to the other.

This unit weighs approximately 290 pounds and may, therefore, require a somewhat sturdier than normal instrument stand or table.

2. INSTALLATION IN THE RELAY RACK. The Universal Microwave Power Supply may be mounted in any standard 19" Relay Rack where a vertical space of 21" and depth of 21" is available. The unit will mount directly. However, provision should be made to clear the rear of the handles or else remove them completely from the unit. If any vibration is present, additional support may be necessary to reinforce the Relay Rack. Clearance should be provided for the rear fan, and if air circulation in the rack is not filtered, a filter should be provided over the fan for the Z817.

NOTE: BEFORE USING THIS PIECE OF EQUIPMENT, THE USER SHOULD MAKE CERTAIN THAT HE IS COMPLETELY FAMILIAR WITH ALL CONTROLS AND THEIR PROPER USE, AND WITH THE SPECIFICATIONS AND LIMITATIONS OF ITS OUTPUTS.

CAUTION: THIS UNIT PRODUCES HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE.

1. CONNECTING THE UNIVERSAL MICROWAVE POWER SUPPLY. The following preliminary procedure should be followed:

Make certain the line and HV toggle switches are off.

Connect the line cord to the proper power source.

Connect the third wire of the input line cord to a good ground or suitably ground the power supply cabinet.

Before turning the unit on, make certain that all connections are secure - particularly the reflector and control grid for klystrons and the G-1 electrode for BSW's, TWAT's, and VTM's.

All outputs originate from the single input connector S-201.

When using this supply cable, it is suggested that the interlock, J & K, be located at the tube mount if the cable is not a permanent part of the mount. Although shielding cables of the high impedance sources is permissible, capacitance should be kept to a minimum so as not to degrade the modulator performance.

2. USE OF PANEL CONTROLS.

CONTROL	SETTING	FUNCTION
Line (Toggle Switch)	Off - On	Applies power to and removes it from entire unit.
HV (Toggle Switch)	Off - On	Applies power to and removes it from all HV and focusing supplies.
Overload (Rotary Control)	10 - 125 Ma.	Sets value at which Beam supply will overload. Turns off all HV and focusing electrode power supplies.
Reset (Push Button)		Restores unit to operating condition. Resets regardless of where overload occurred, i.e. collector, anode or beam.

CONTROL	SETTING	FUNCTION
Ground (Rotary Switch)	"Coll (+)" "(+) or (-)" "Beam" "None" Setting depends on required operation.	Establishes a ground point internally.

NOTE: ALWAYS MAKE CERTAIN THE CORRECT GROUND POINT IS ESTABLISHED BEFORE TURNING UNIT ON.

CAUTION: NEVER CHANGE SWITCH POSITION WHEN HV IS ON.

Range (Rotary Switch)	0 to 1800V or 1700 to 3500V	Sets Beam voltage range.

NOTE: IT IS ALWAYS DESIRABLE TO RETURN THE UNIT TO LOW RANGE AFTER USE TO HELP PROTECT AGAINST DANGEROUS ACCIDENTAL USE.

Beam Voltage (Rotary Control)	0 - 3500V	Sets Beam voltage applied to output connector; accurate to ±1%.
Fine Beam Voltage (Rotary Control)	0 - 7.2V	Vernier setting of Beam voltage, adds to main dial setting. Resolution 20 - 30 MV.
Filament (Rotary Switch)	Volts or Amps.	Establish meter mode of operation.
Filament (Rotary Control)	0 - 15 arbitrary units. Changes Fil. supply output voltage.	Scale indicates arbitrary.

NOTE: ALWAYS RETURN FILAMENT SUPPLY VOLTAGE TO ZERO AFTER USE.

CONTROL	SETTING	FUNCTION
Collector (Rotary Switch)	Volts; Ma	Establish meter mode of operation.
Collector (Rotary Control)	0 - 300VB (accurate presettable voltage).	Sets collector supply output voltage.
Collector (Rotary Control)	0 - 300V (accurate presettable voltage).	Sets collector supply output voltage.
Anode (Rotary Control)	0 - 600V (accurate presettable voltage).	Sets Anode Supply output voltage.
G-1 (Rotary Switch)	Volts; Ma	Establish meter mode of operation.
G-1 (Rotary Control)	0 - 300V (accurate presettable voltage for N. L. condition).	Sets G-1 supply output voltage.
G-2 (Reflector), G-3, G-4 (Rotary Switch)	Volts; Ma	Establish meter mode of operation.
G-2 (Reflector), G-3, G-4 (Rotary Switch)	G-2, G-3, G-4	Indicates to which source the meter is applied.
G-2 (Rotary Control)	0 - 1200V (accurate presettable voltage for N. L. condition).	Indicates G-2 output voltage.

CONTROL	SETTING	FUNCTION
G-3 (Rotary Control)	0 - 750V (accurate presettable voltage for N. L. condition).	Indicates G-3 output voltage.
G-4 (Rotary Control)	0 - 500V (accurate presettable voltage for N. L. condition).	Indicates G-4 output voltage.
Polarity (Rotary Switch)	(+), (-)	Indicates polarity of G-2 (Reflector), G-3, G-4 supplies relative to negative side of Anode supply.
Frequency (Rotary Control)	250 - 2500 40 - 120	Indicates frequency of saw tooth, pulse, and square wave outputs of the internal modulator.
External, AGC (Rotary Switch	Off, sym. Anode, G-1, G-2	Indicates supply to which external modulator is being supplied.
Internal (Rotary Switch)	Off, Anode, G-1, G-2	Indicates supply to which internal modulation is being supplied.
Type (Rotary Switch)	Off	Indicates type of internal modulation in use.
Pulse Width (Rotary Control)	1 - 10	Indicates the nominal pulse width from 1 - 10 μsec.
Amplitude (Rotary Control)	0 - 200	Indicates nominal internal modulation amplitude from 0 - 200 volts.

3. PANEL INDICATORS AND CONNECTORS.

3.1 Indicators

3.1.1	Line (Pilot Lamp)	Lamp lights when line toggle switch is "ON".
3.1.2	HV (Pilot Lamp)	Lamp lights when HV toggle switch is "ON" and the line toggle switch has been on at least 60 seconds. An overload will extinguish this indicator, but overload pilot lamp will then go on.
3.1.3	Overload (Pilot Lamp)	Lamp lights when overload relay is tripped.

3.2 Fuses

3.2.1	Line (Two 10 amp fuses)	Protects against a general overload. Use 10 ampere quick blow fuses.
3.2.2	HV (One 8 amp fuse)	Protects all power circuits in the HV switch line. Use 8 ampere quick blow fuse.

3.3 Connectors

3.3.1	Output (Amphenol Type 405 or equivalent, 15 pin connector)	All output power available from this connector. A mating connector is supplied.
3.3.2	Fan (Standard AC female connector)	Provides outlet for external fans or other low power loads. Load not to exceed 0.6 amperes.
3.3.2	Ext (BNC connector)	Input for external modulation.

3.4 Meters, all D. C.

3.4.1	Beam Voltage (4" linear scale, 0 - 400V, ±2%)	This meter reads Beam voltage and thereby offers a general check on Beam supply operation. As long as the dial and meter agree to ±3%, the beam supply is working normally. The dial accuracy is better than the meter (±1%).
3.4.2	Beam Current (4" non-linear scale 0 - I5 Ma, ±3% of reading or 1 Ma whichever is greater)	This meter reads Beam current. It is on the plate side of the series pass tubes and is surpressed to read zero for no external load (actual current is approximately 3.6 Ma).
3.4.3	Filament; Voltammeter (3" linear scale, 0 - 15V; 0 - 3 amp, ±2%)	This meter reads output voltage or current of the D. C. Filament supply.
3.4.4	Collector; Voltmilliammeter (3" non-linear scale, 0 - 300V, 0 - 120 Ma, ±2%)	This current reads the output voltage and current of the Collector supply.
3.4.5	Anode; Voltmilliammeter (3" non-linear scale, 0 - 300V, 0 - 120 Ma, ±2%)	This meter reads the output voltage and current of the Anode supply.
3.4.6	G-1; Voltmilliammeter (3" non-linear scale, 0 - 300V, 0 - 5 Ma, ±2%)	This meter reads the output voltage and current of the G-1 supply.

3.4.7	G-2 (Reflector), G-3, G-4 Volt-milliammeter (3" linear scale, zero center, 1200 - 0 - 1200V and 1 - 0 Ma, ±2%)	This meter reads the output voltage and current of the G-2 (Reflector), G-3 and G-4 supplies.

4. USING UNIVERSAL MICROWAVE POWER SUPPLY.

NOTE: BEFORE USING THIS PIECE OF EQUIPMENT, THE USER SHOULD MAKE CERTAIN THAT HE IS COMPLETELY FAMILIAR WITH ALL CONTROLS AND THEIR PROPER USE AND ALSO WITH THE SPECIFICATIONS AND LIMITATIONS OF ITS OUTPUTS.

CAUTION: THIS UNIT PRODUCES HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE.

4.1 Operation

NOTE: ALL OF THE SUPPLIES IN THE UNIVERSAL MICROWAVE POWER SUPPLY ARE FLOATING. THEY SHOULD BE CONNECTED TOGETHER AS NECESSARY AT THE TUBE SOCKET OF THE TUBE MOUNT.

4.1.1 For Use With Klystrons

4.1.1.1 Plug Klystron into tube mount and set up associate equipment. If blower is necessary and FXR Tube Mounts are not being used, the blower motor may be connected to the AC output socket on the front panel. The motor should not draw more than 0.6 amperes. The output connector must have its interlock closed, short from J to K, for the unit to operate. See Section III, paragraph 1.

4.1.1.2 Set Filament control to zero.

4.1.1.3 Check HV switch, it should be "OFF".

4.1.1.4 Turn Line switch "ON". The dial lights will illuminate the Beam dial.

4.1.1.5 Note correct Filament operation in manufacturer's tube specs. Set Filament to voltage slowly - if data is given primarily to voltage. Generally as the tube warms the voltage will rise, therefore, it is preferrable to set the voltage below the final value and as the tube stabilizes, after about 30 seconds, increase to final value. If data is given in current, observe current on the meter and raise voltage to correct current. As tube warms up, current will fall. After 30 seconds, increase to final value.

4.1.1.6 Set polarity switch to (-). The indicating meter will read in red if (+). Turn off immediately, since a positive reflector will damage the klystron.

NOTE: DO NOT REVERSE POLARITY SWITCH WHILE HV IS ON.

4.1.1.7 Set G-2, Reflector, to approximately the correct value (see manufacturer's tube specs.).

4.1.1.8 Set meter to G-2 (see manufacturer's tube specs.).

4.1.1.9 Set G-1 to correct potential if tube requires negative control grid. To eliminate surges, some tubes require a highly negative control voltage upon starting.

4.1.1.10 Set anode to correct potential if tube requires positive control grid.

4.1.1.11 Set Beam supply to correct Beam voltage.

4.1.1.12 Set ground to Beam (+). This is normal position for ground when using klystron. Operation with other grounding is permissible if tube mount and waveguide are properly constructed.

4.1.1.13 Set overload to desired level.

4.1.1.14 If no modulation is desired;

4.1.1.14.1 Set internal "OFF".

4.1.1.14.2 Set Ext. AGC "OFF".

4.1.1.14.3 Set type "OFF".

4.1.1.15 If only internal modulation is desired:

4.1.1.15.1 Set Int. to electrode to which the modulator should go, normally G-2 (Reflector).

4.1.1.15.2 Set Ext. AGC "OFF".

4.1.1.15.3 Set type to modulation waveshape desired.

4.1.1.15.4 Set frequency to frequency desired.

4.1.1.15.5 Set pulse width to the desired width if this is type of operration.

4.1.1.15.6 Set amplitude to zero. Normally amplitude is best adjusted when HV is on and the tube is oscillating.

4.1.1.16 If only external modulation is desired;

4.1.1.16.1 Set internal to electrode to which modulation should be applied.

4.1.1.16.2 Set External, AGC, to same position as internal.

4.1.1.16.3 Set type to "OFF".

4.1.1.17 If external and internal modulation is desired - for AGC or AFC;

4.1.1.17.1 Set up as in paragraph 4.1.1.15 except set Ext. AGC as in paragraph 4.1.1.15.1.

4.1.1.18 Turn HV "ON".

NOTE: MAKE CERTAIN ALLOTED WARM-UP TIME HAS ELAPSED FOR THE FILAMENT OF THE TUBE UNDER TEST BEFORE TURNING HV ON. THE INTERNAL TIME DELAY IS NOMINALLY 60 SECONDS. HOWEVER, SOME TIME IS SPENT IN ESTABLISHING THE PROPER FILAMENT OPERATION AND THE TUBES WARM-UP MAY NOT BE COMPLETE IF ONLY THIS DELAY IS USED BEFORE HV IS TURNED ON.

Adjust reflector and control grid (if necessary) until desired operation is achieved. Normal oscillation may be noted by observing deflection of the Beam current meter. If square wave modulation is being used and the RF output is being registered on a Standing Wave Amplifier such as the FXR Type B812A, the modulator should be adjusted to the amplifier's sensitive frequency. The Frequency dial is operated by a vernier mechanism which makes it possible to change the frequency by small increments.

4.1.2 For Use With BWO, TWAT, and VTM.

4.1.2.1 Observe all conditions paragraph 4.1.1.1 through paragraph 4.1.1.18. However, if additional focusing voltages are necessary, switch polarity switch to (+) and use G-2, G-3, and G-4.

NOTE: IF MODULATION IS APPLIED TO G-2, G-3 and G-4 ARE ALSO MODULATED.

MODULATION OF THESE TUBES NORMALLY IS REQUIRED ON THE ANODE AND G-1 ELECTRODES.

External modulation may be used for AGC to stabilize the power output of the tube in use as the tube is swept - see next paragraph.

4.1.3 For Swept Operation with FXR - Z818A Voltage Sweeper.

4.1.3.1 All supplies of the Z817A are floating and insulated from each other, therefore the Z817A (which is effectively a variable series bucking voltage) may be connected on either side of the beam supply.

4.1.3.2 Care should be taken to assure that all focus voltages are attached to the proper points to maintain their correct relative potential levels. This may be accomplished best by making the connections at the tube socket.

4.3 To Turn Equipment "OFF".

4.3.1 Return Anode to zero (when necessary).

4.3.2 Turn off HV.

4.3.3 Return Filament to zero.

4.3.4 Turn off line.

1. CORRECTIVE MAINTENANCE.

1.1 General. The Universal Microwave Power Supply has been constructed in as compact a manner as possible without complicating repair and testing conditions.

The built-in fan and adequate internal air paths permit cool operation.

NOTE: CARE SHOULD BE TAKEN TO KEEP THE FILTER IN GOOD CONDITION.

EASE OF REPAIR HAS BEEN FACILITATED BY SECTIONAL CONSTRUCTION - EACH CIRCUIT DIAGRAM INDICATES A REMOVABLE ASSEMBLY.

1.1.1 Dismantling

1.1.1.1 To remove upper assemblies, Figures 5, 6, 8, and 9:

1.1.1.1.1 Remove top - four centrally located screws.

1.1.1.1.2 Remove rear door - 6 screws.

1.1.1.1.3 Remove fan wall - 6 blue sheet metal screws.

1.1.1.1.4 Loosen 4 red screws on top of inner shell.

1.1.1.1.5 Disconnect connectors to assembly as required.

1.1.1.1.6 Pull assembly out.

1.1.1.2 To Remove Center Assembly, Figure 4

1.1.1.2.1 Remove unit from cabinet - 8 front panel screws.

1.1.1.2.2 Remove fan wall - 6 blue sheet metal screws.

1.1.1.2.3 Loosen 8 green side - wall screws.

1.1.1.2.4 Disconnect connectors - 6 upper, 1 lower.

1.1.1.3.5 Pull assembly out.

1.1.1.3 Removing Front Panel Assembly. To remove the front panel proceed as follows: Unfasten the rear cover and fan mounting, disconnect front panel plug, 401, disconnect front panel plugs 304, 305, 301, 306, 307, and 309, accessable from the underside of the unit adjacent to the front panel. Remove the screws and handles about the periphery of the panel, then pull the front panel out carefully. The modulator unit is fastened to the front panel. It extends well behind the panel. Care should be exercised to insure that it is not damaged.

1.2 Relays.

1.2.1 Relays are used in overload and sequencing service. It is advisable to keep the contacts in good condition. Unnecessary and dangerous transients and chattering may result if this is not done.

1.3 Fuses.

1.3.1 The use of proper fusing protects both equipment and tubes. Do not use slow blow fuses.

1.4 Servicing Supplies.

1.4.1 Conventional electronic servicing techniques are adequate for this unit. Schematic diagrams are located in Section IV.

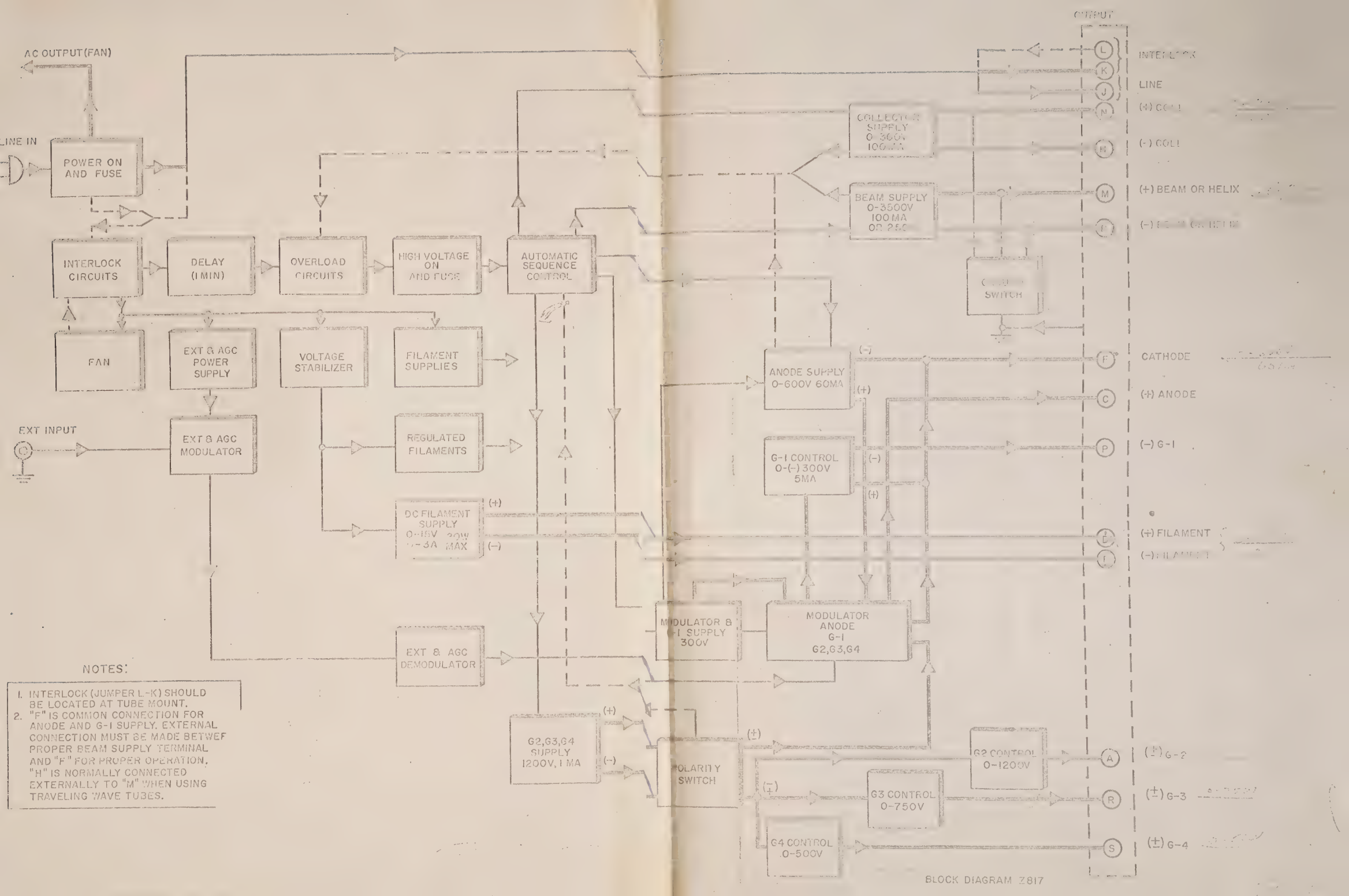
If it becomes necessary to re-adjust the tracking dial meter accuracy of the collector, Anode, or Beam supplies, proceed as follows: For Collector and Anode supplies, set the front panel control to maximum output and adjust the rear potentiometer, accessable from the top of the unit, over the particular supply being adjusted, for a full scale meter indication. Reset the front panel control for 0 volts and adjust the front potentiometer for zero meter reading. Follow the same procedure on the Beam supply with it set on the low range. On the high range of the Beam supply, there is only one adjustment to be made at 1700 volts. This potentiometer is located to the left of the two low range potentiometers.

NOTE

TO REMOVE FRONT PANEL

1. REMOVE HANDLES (TWO SCREWS

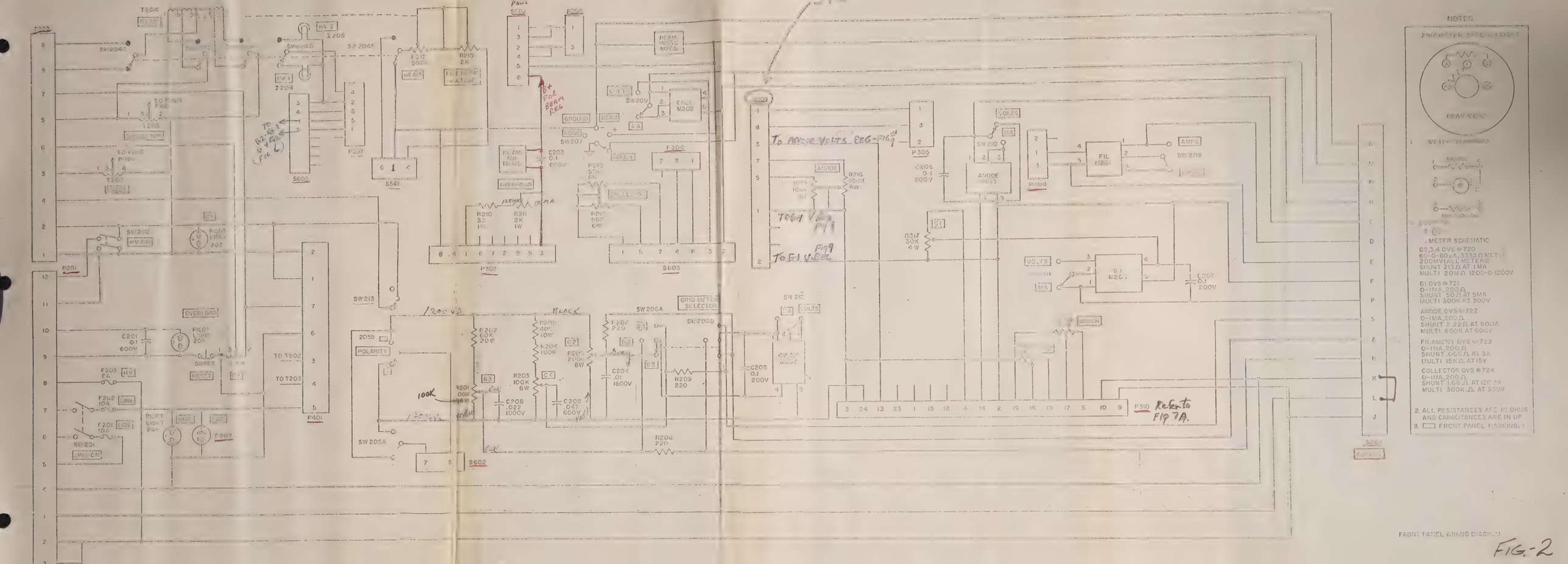
2 - REMOVE TWO SCREWS IN BACK OF MODULATOR & PULL OUT SLOWLY.



NOTES:

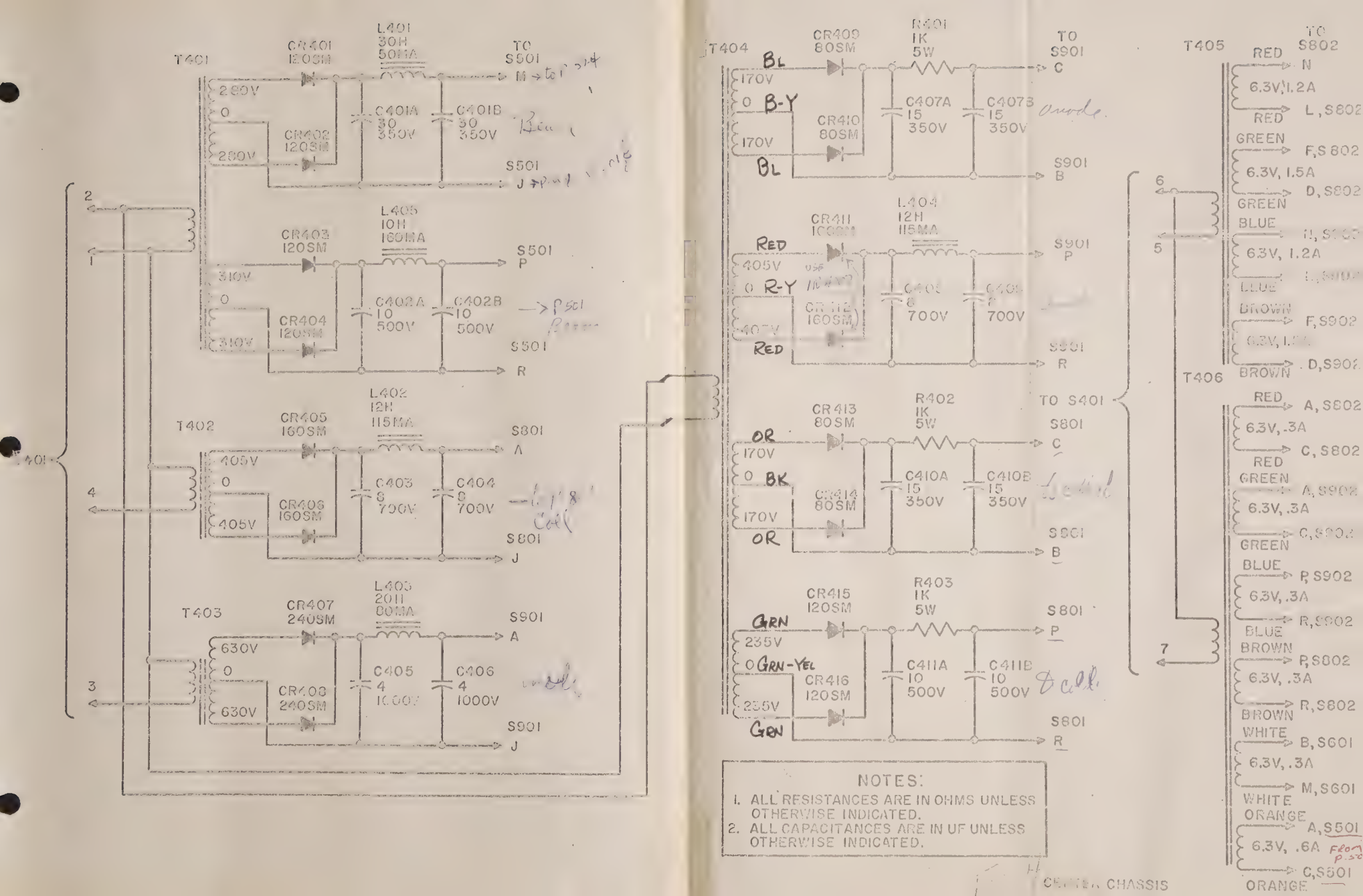
1. INTERLOCK (JUMPER L-K) SHOULD BE LOCATED AT TUBE MOUNT.
2. "F" IS COMMON CONNECTION FOR ANODE AND G-1 SUPPLY. EXTERNAL CONNECTION MUST BE MADE BETWEF PROPER BEAM SUPPLY TERMINAL AND "F" FOR PROPER OPERATION. "H" IS NORMALLY CONNECTED EXTERNALLY TO "M" WHEN USING TRAVELING WAVE TUBES.

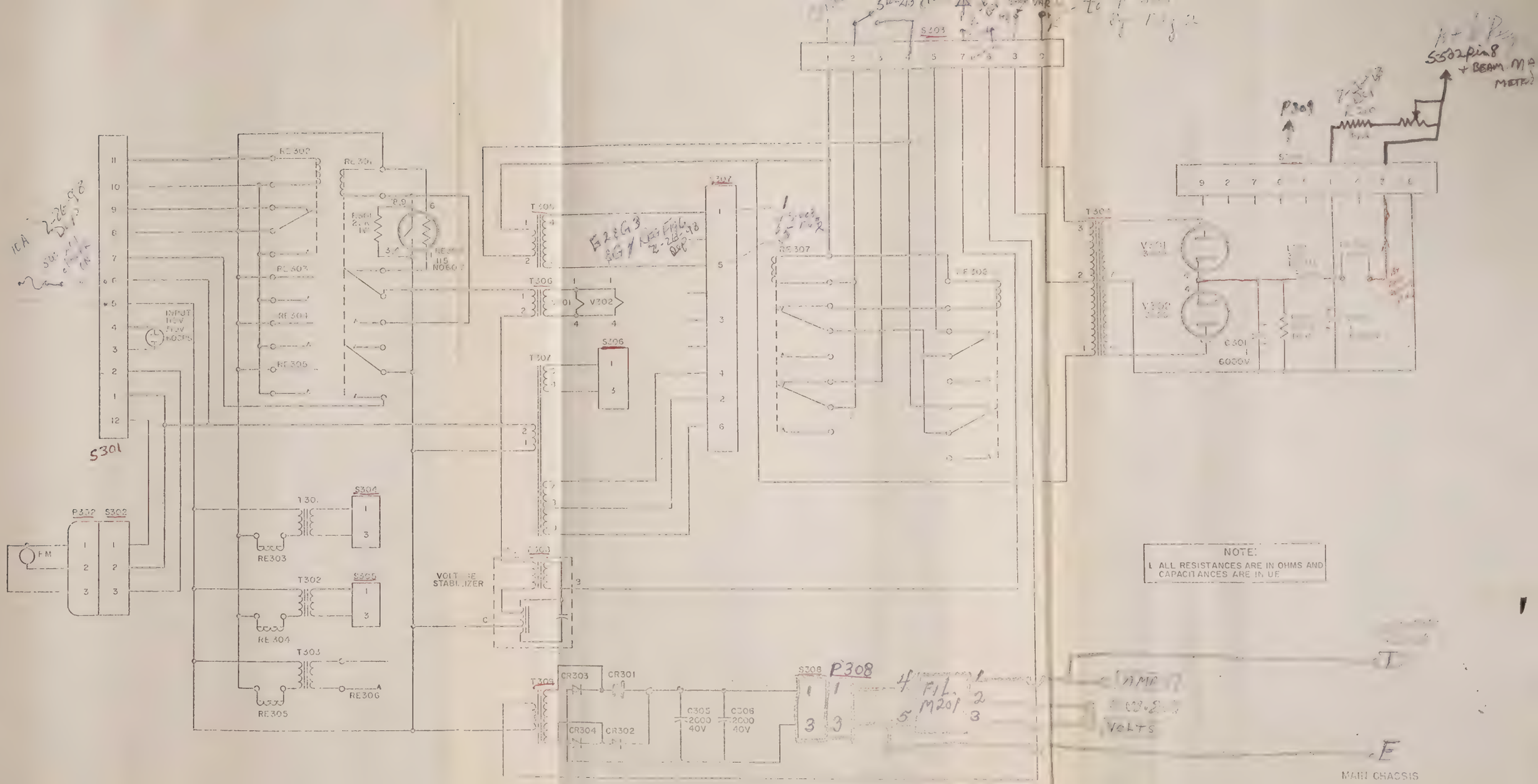
BLOCK DIAGRAM Z817

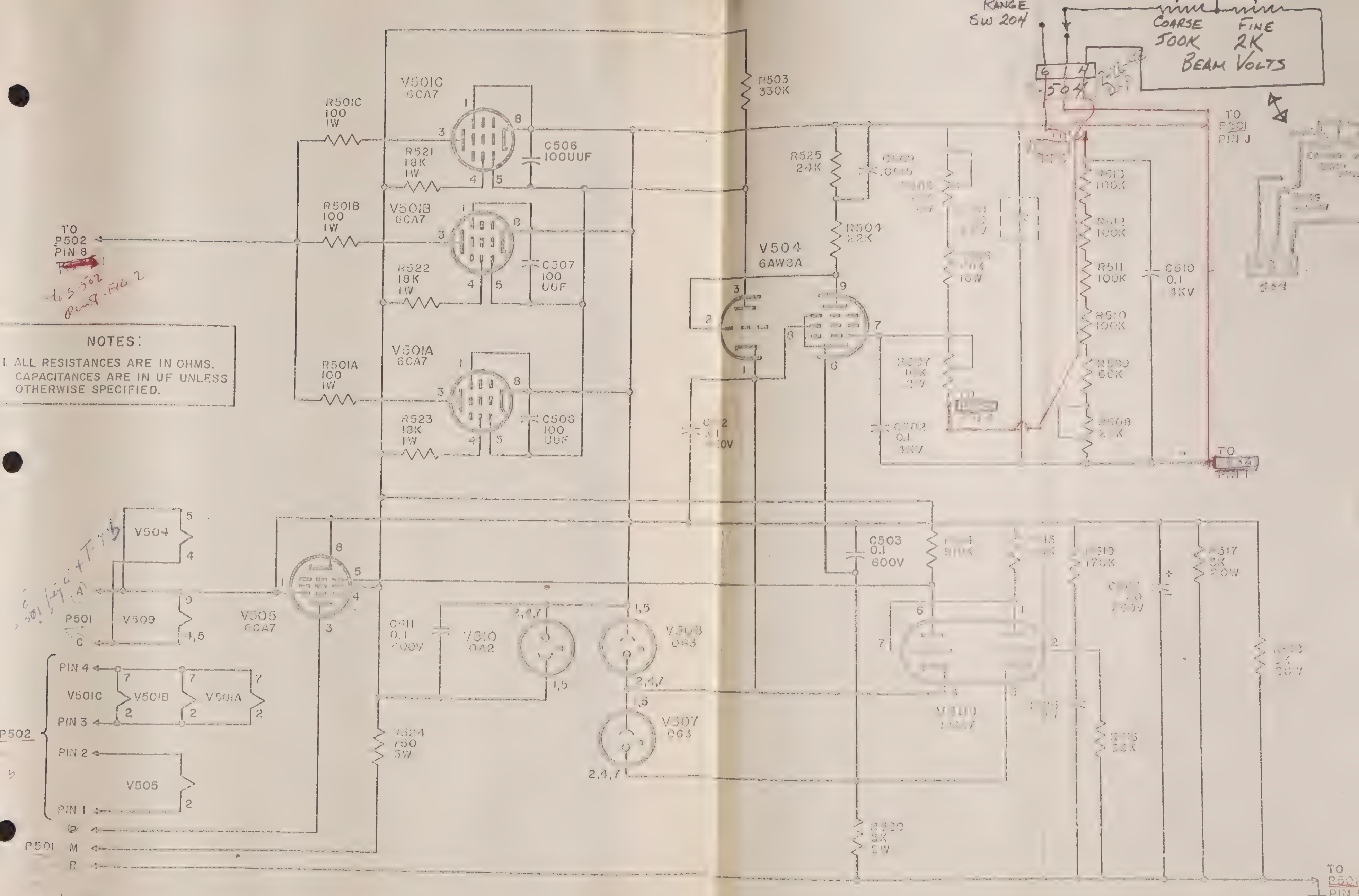


FRONT PANEL WIRING DIAGRAM

FIG. 2


T401
CR401 120SM
L401 30H 50MA
TO S501
M
280V
0
280V
CR402 120SM
C401A 30 350V
C401B 30 350V
S501
J
L405 10H 160MA
CR403 120SM
S501
P
310V
0
310V
CR404 120SM
C402A 10 500V
C402B 10 500V
S501
R
T402
CR405 160SM
L402 12H 115MA
S801
A
405V
0
405V
CR406 160SM
C403 8 700V
C404 8 700V
S801
J
T403
CR407 240SM
L403 20H 80MA
S901
A
630V
0
630V
CR408 240SM
C405 4 1000V
C406 4 1000V
S901
J
T404
CR409 80SM
R401 1K 5W
TO S901
C
BL
170V
0 B-Y
170V
BL
CR410 80SM
C407A 15 350V
C407B 15 350V
S901
B
L404 12H 115MA
CR411 160SM
S901
P
RED
405V
0 R-Y
405V
RED
CR412 160SM
C408 8 700V
C409 8 700V
S901
R
R402 1K 5W
TO S401
CR413 80SM
S801
C
OR
170V
0 BK
170V
OR
CR414 80SM
C410A 15 350V
C410B 15 350V
S801
B
R403 1K 5W
CR415 120SM
S801
P
GRN
235V
0 GRN-YEL
235V
GRN
CR416 120SM
C411A 10 500V
C411B 10 500V
S801
R
T405
TO S802
RED
N
6.3V, 1.2A
L, S802
RED
GREEN
F, S802
6.3V, 1.5A
D, S802
GREEN
BLUE
6.3V, 1.2A
BLUE
BROWN
F, S902
BROWN
D, S902
T406
RED
A, S802
6.3V, .3A
C, S802
RED
GREEN
A, S902
6.3V, .3A
C, S902
GREEN
BLUE
P, S902
6.3V, .3A
R, S902
BLUE
BROWN
P, S802
6.3V, .3A
R, S802
BROWN
WHITE
B, S601
6.3V, .3A
M, S601
WHITE
ORANGE
A, S501
6.3V, .6A
C, S501
ORANGE
1
2
3
4
5
6
7
401
NOTES:
1. ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCES ARE IN UF UNLESS OTHERWISE INDICATED.
CHASSIS


S301
RE302
RE301
RE303
RE304
RE305
RE306
T301
T302
T303
T304
T305
T306
T307
V301
V302
V303
S302
S303
S304
S305
S306
P302
P308
P309
CR301
CR302
CR303
CR304
C305
2000 40V
C306
2000 40V
C301
6000V
INPUT 115V 60CPS
VOLTAGE STABILIZER
FM
RE307
NOTE:
1. ALL RESISTANCES ARE IN OHMS AND CAPACITANCES ARE IN UF
MAIN CHASSIS

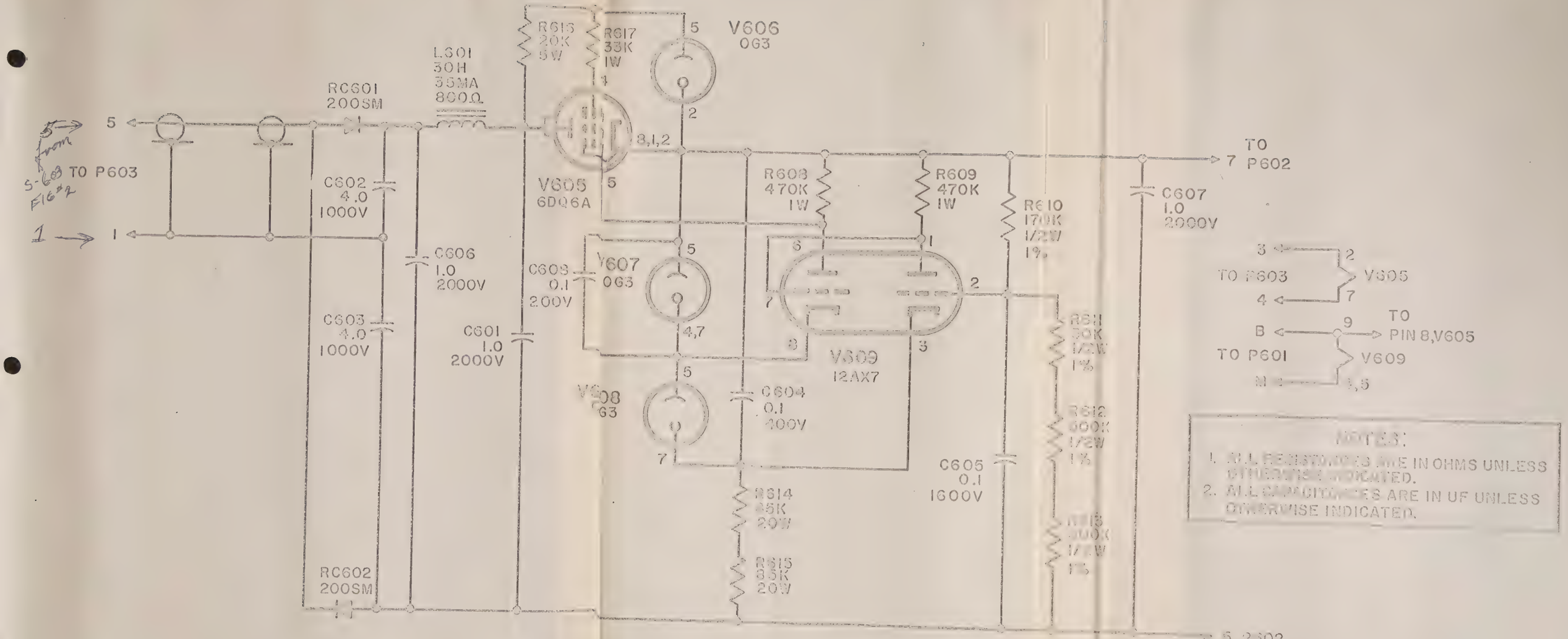

RANGE
SW 204
COARSE
500K
FINE
2K
BEAM VOLTS
504
V501C
6CA7
R501C
100
1W
R521
18K
1W
C506
100UUF
R503
330K
R525
24K
TO
P501
PIN J
R501B
100
1W
V501B
6CA7
R522
18K
1W
C507
100
UUF
R504
22K
V504
6AW3A
R511
100K
C510
0.1
R510
100K
TO
P502
PIN 8
-to S-502
Pin 8 - FIG 2
V501A
6CA7
R501A
100
1W
R523
13K
1W
C508
100
UUF
0.1
V504
V509
P501
A
C
V505
6CA7
C503
0.1
600V
R517
20W
PIN 4
V501C
V501B
V501A
PIN 3
P502
PIN 2
V505
PIN 1
P501
M
R
R524
750
5W
V507
0C3
TO
PIN

NOTES:

1. ALL RESISTANCES ARE IN OHMS. CAPACITANCES ARE IN UF UNLESS OTHERWISE SPECIFIED.

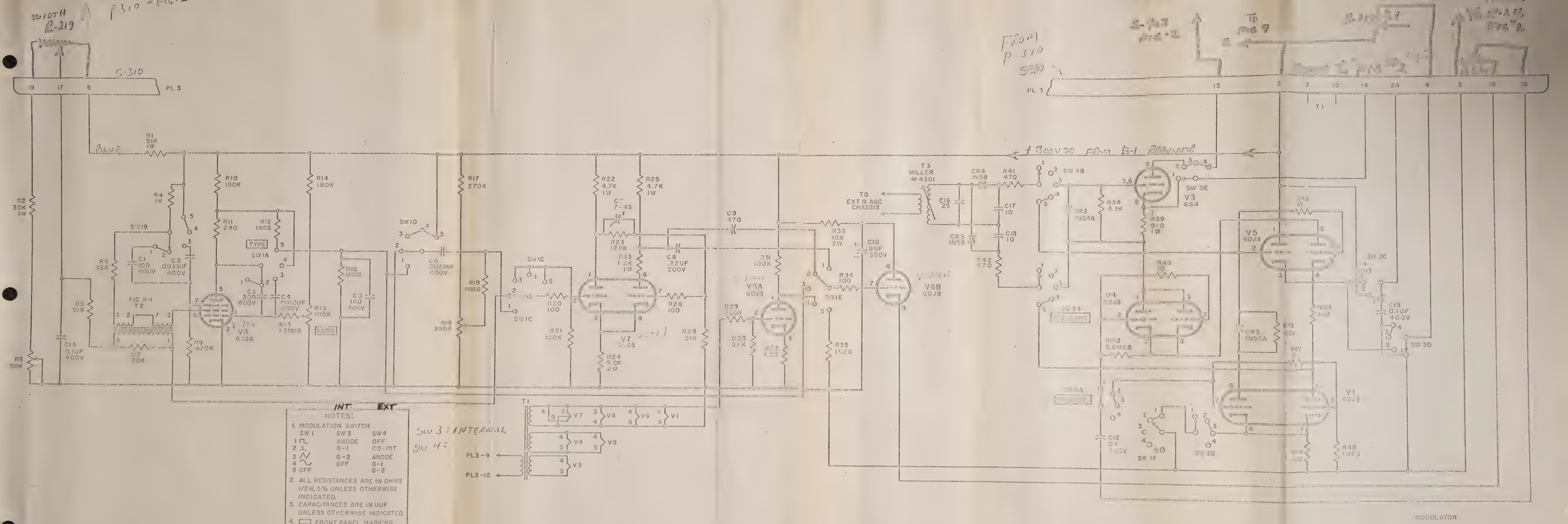
BEAM SUPPLY(BEAM REGULATOR & REFERENCE SUPPLY)

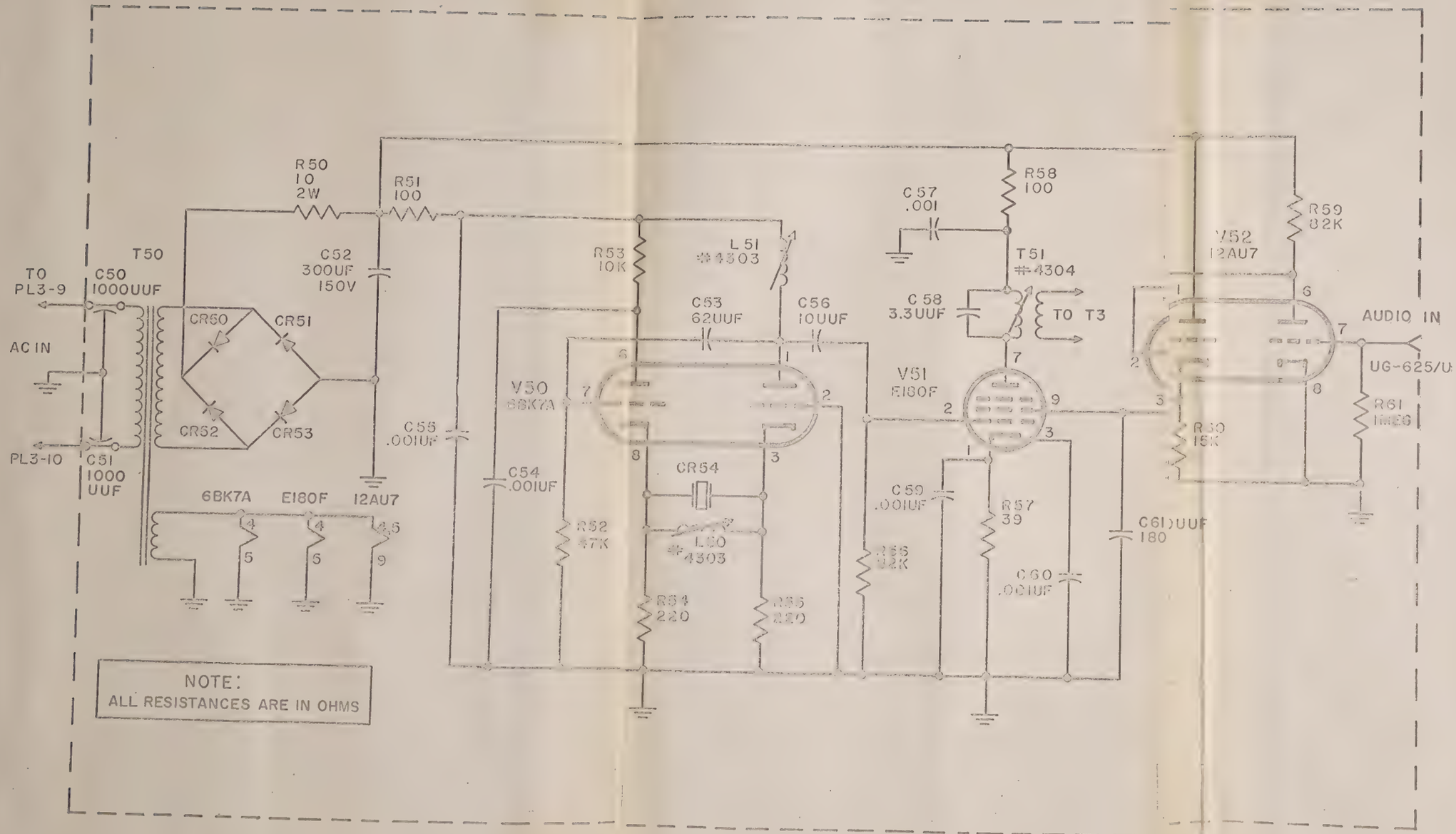
FIG 5



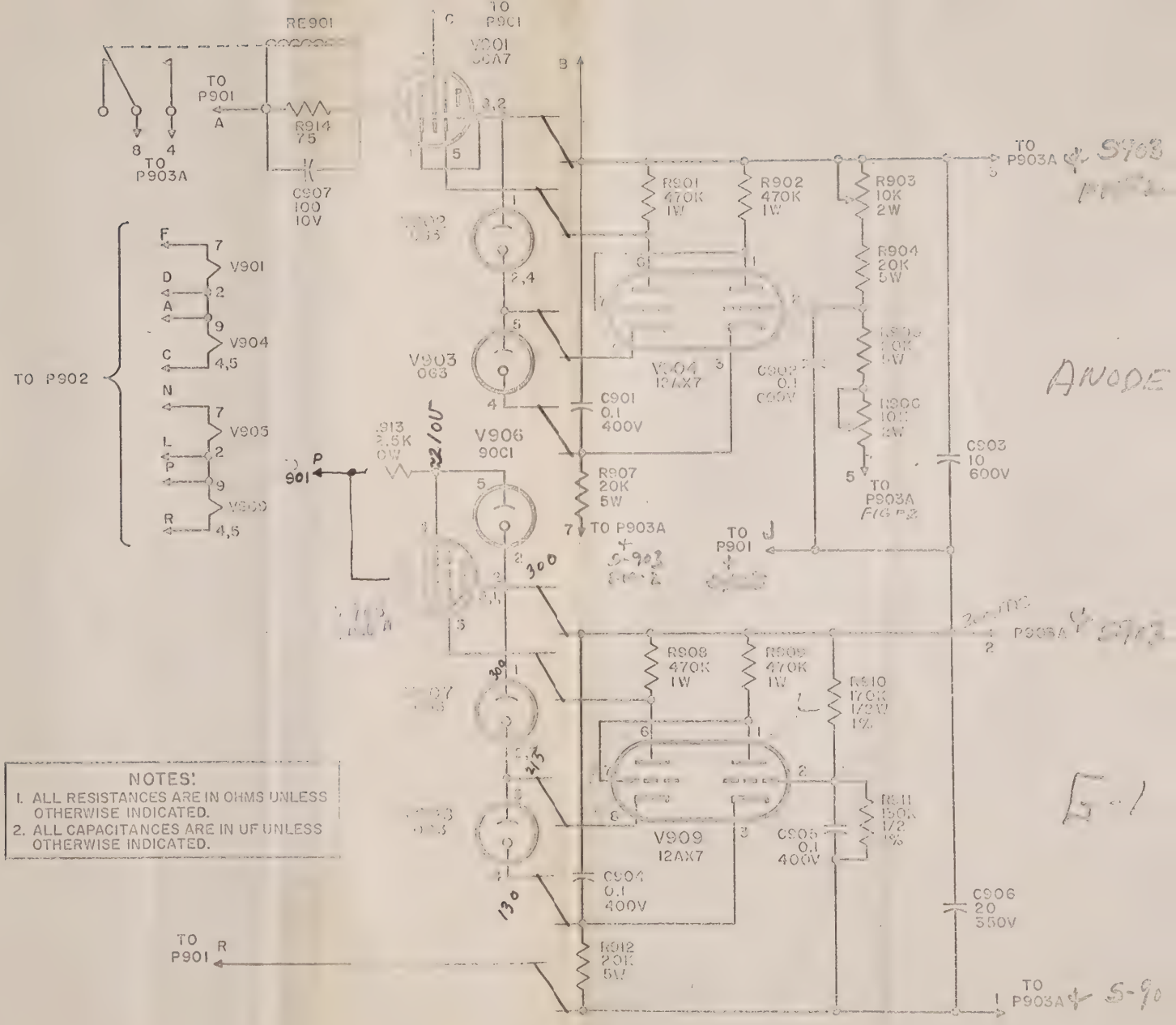
NOTES:

1. ALL RESISTORS ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE INDICATED.


WITH R-219
P-310
S-310
PL 3
19 17 5
BLUE
R1 51K 1W
R2 30K 1W
R3 50K
R4 1K
R5 91K
R6 45K
R7 20K
R9 470K
R10 180K
R11 240
R12 1MEG
R13 1.2MEG
R14 180K
R15 100K
R16 1MEG
R17 270K
R18 250K
R19 1MEG
R20 100
R21 100K
R22 4.7K 1W
R23 120K
R24 6.8K 2W
R25 4.7K 1W
R26 100
R27 91K
R29 250K
R30 51K
R31 100K
R32 1.5K
R34 100
R35 1MEG
R36 10K 2W
R38 4.3K
R39 910 1W
R40 5.6MEG
R41 470
R42 470
R43 10
R44 10
R45 10
R46 10
R47
R48 1MEG
C1 100 400V
C2 .0033UF 400V
C3 300 400V
C3 160 400V
C4 .0033UF 400V
C6 .0028UF 400V
C7 7-45
C8 .22UF 200V
C9 470
C10 .01UF 350V
C10 .01UF 400V
C11 .1UF 400V
C12 .01 400V
C15 0.1UF 400V
C16 25
C17 10
C18 10
CR1 IN34A
CR2 IN54A
CR3 IN54A
CR4 IN58
CR5 IN58
T1
T2
T3 MILLER #4301
TO EXT & AGC CHASSIS
V1 6AB6
V2 6AB6
V3 6S4
V4 6DJ8
V5 6DJ8
V6A 6DJ8
V6B 6DJ8
V7 6AB5
VI 6DJ8
SW1A
SW1B
SW1C
SW1D
SW1E
SW1F
SW2A
SW2B
SW2C
SW2D
SW2E
SW3A
SW3B
SW3C
SW3D
SW3E
SW4A
SW4B
PIC K-1
TYPE
+300V DC FROM B-1 REGULATOR
FROM P-310 S2A
TO PG 9
S-310 PG-2
PL3-9
PL3-10
PL 3
13 2 9 10 14 24 4 3 18 16
T1
V7 V8 V6 V1
V4 V5
V3
INT. EXT
SW 3 = INTERNAL
SW 4 =
NOTES:
1. MODULATION SWITCH
SW I SW 3 SW 4
1 ⊓ ANODE OFF
2 ⊥ G-1 CO-INT
3 ∿ G-2 ANODE
4 ∿ OFF G-1
5 OFF G-2
2. ALL RESISTANCES ARE IN OHMS 1/2W, 5% UNLESS OTHERWISE INDICATED.
3. CAPACITANCES ARE IN UUF UNLESS OTHERWISE INDICATED.
4. ▭ FRONT PANEL MARKING.
MODULATOR


R50
10
2W
R51
100
T50
TO
PL3-9
C50
1000UUF
AC IN
PL3-10
C51
1000
UUF
C52
300UF
150V
CR50
CR51
CR52
CR53
C55
.001UF
6BK7A
E180F
12AU7
R53
10K
L51
#4303
C53
62UUF
C56
10UUF
V50
6BK7A
C54
.001UF
R52
47K
CR54
L50
#4303
R54
220
R55
220
C57
.001
R58
100
T51
#4304
C58
3.3UUF
TO T3
V51
E180F
C59
.001UF
R57
39
C60
.001UF
R56
82K
C61
180
V52
12AU7
R59
82K
R60
15K
AUDIO IN
UG-625/U
R61
1MEG
NOTE:
ALL RESISTANCES ARE IN OHMS

EXT AND AGC



ANODE AND G-1 REGULATORS

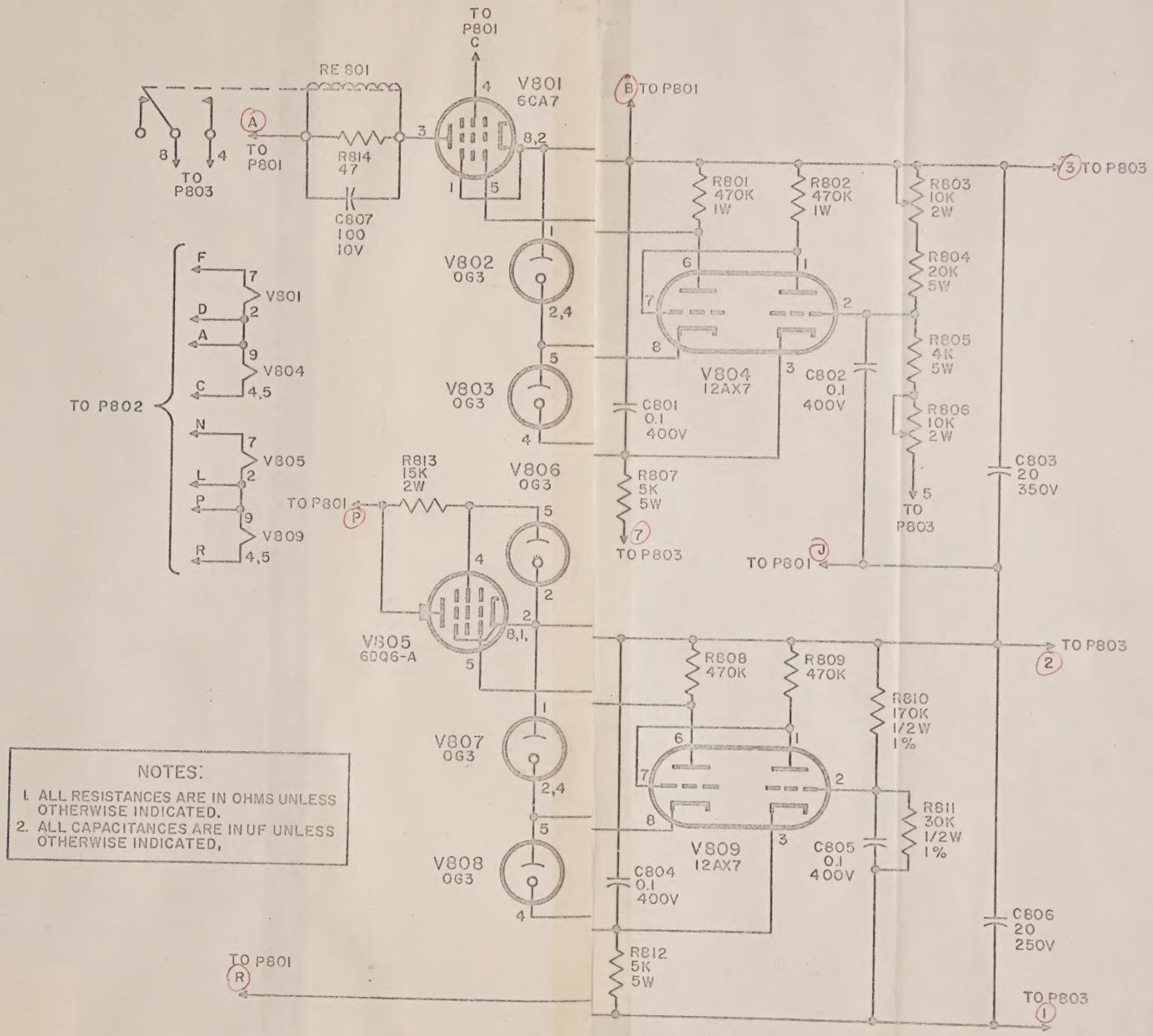

TO P801 C
RE 801
V801 6CA7
A
TO P801
8
4
TO P803
R814 47
C807 100 10V
B TO P801
R801 470K 1W
R802 470K 1W
R803 10K 2W
3 TO P803
R804 20K 5W
R805 4K 5W
R806 10K 2W
5 TO P803
V802 0G3
V803 0G3
V804 12AX7
C801 0.1 400V
C802 0.1 400V
C803 20 350V
R807 5K 5W
7 TO P803
TO P801 J
TO P802
F
D
A
C
N
L
P
R
V801
V804
V805
V809
R813 15K 2W
TO P801 P
V806 0G3
V805 6DQ6-A
V807 0G3
V808 0G3
TO P803 2
R808 470K
R809 470K
R810 170K 1/2W 1%
R811 30K 1/2W 1%
V809 12AX7
C804 0.1 400V
C805 0.1 400V
C806 20 250V
R812 5K 5W
TO P801 R
TO P803 1
NOTES:
1. ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCES ARE IN UF UNLESS OTHERWISE INDICATED,
COLLECTOR SUPPLY

Fig 8